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ABSTRACT

The purpose of the present study was to examine the effects of game-like learning activities, as compared to rote memorization procedures, on preschool subjects (n=8) recitation of their home telephone numbers. A rhyming mnemonic memory device was incorporated into the game procedures. A group design was used with a pretest-training-posttest format for both training groups. Analyses of the individual and group data indicate that subjects trained with the rote memorization procedures made fewer errors during training, demonstrated more accurate acquisition of the digit-chains, and demonstrated retention after a longer period of time than the subjects who were trained with the game procedures. Task difficulty and the daily criterion-level probe format may have influenced the results. The effects observed indicate that further research is necessary on the efficacy of game-like academic training with young children. (Author/RH)

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MEMORIZATION TASKS:

ROTE LEARNING VS. "FUN" LEARNING

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Running Head: Rote Learning vs. "Fun" Learning

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Memorization of chains of numerals for short-term retention is a simple, common process for most adults (e.g., car license and social security numbers, phone numbers and addresses, etc.). For children, throughout the school years, committing information to memory is integral to education at all levels (e.g., rote counting, multiplication tables, metric measurements, etc.). Programmed materials, a recent trend in educational procedures, have given memorization a more important role in the learning process (Hastings, 1977). In the present study, two methods of training memorization of a verbal chain were examined with a preschool-aged population, using recitation of the subjects' home telephone numbers as the task.

The experimental format for presentation of the memory task, in comparison to the control format, was influenced by several factors. Concrete stimuli were used, as they are more likely to evoke the required associative "learning and memory (Paivio, 1969)." Also, a mnemonic memory technique was used in the experimental procedures. "Every good boy deserves favor" is a well-known mnemonic for learning musical notation. Another type of mnemonic often used by memory artists and researchers, alike, involves the use of numerical rhymes and mental "imagery." This technique combines previously learned paired-associates rhymes (e.g., one-sun, two-shoe, etc.) with to-be-learned material in perceptual images which ostensibly facilitate response retrieval (Paivio, 1969). Although there is a long-standing controversy concerning the validity of studying

imagery, Bugelski (1970) cited the observed success of deaf children with no known language in paired associates training, to support the belief that they probably relied on imagery to learn the associations.

To ensure that the memorization task was motivating for all subjects, each child's home telephone number was chosen as the verbal chain to be memorized. Knowledge of phone use can increase a child's self-concept and safety in public (ERIC/ECE Newsletter, 1978), as well as help to satisfy parental aspirations by ensuring that the child has one of the common incidental requirements for higher reading group placement in kindergarten.

The most important experimental variable examined involved a manipulation of the child's "enjoyment" of the task. For centuries, it has been believed that play and games have an important effect on cognition (Shears and Bower, 1974; Humphrey, 1969), and in the past decade, the game approach to teaching has gained popularity among educators of young children (Robison, 1977). It has been suggested that young children's motivation to participate in activities is predicated on their desire for movement (Shears and Bower, 1974; Kagan, 1975; Hermann, 1976). One research study which was designed to test the differences between active games and traditional teaching methods found the results favored the active game group at the .06 level (Humphrey, 1969).

In the present study, an experimental training method using a motorically-involving game activity, a mnemonic device, and concrete stimuli, was compared to a control training method using mere repetition, a form of rote learning. The effectiveness of the two procedures was compared using a group design with a pretest-training-posttest format for the experimental and control groups. Across children in each group the

individual data were compared for consistent trends in acquisition, training errors, and retention.

Method

Subjects and Setting

Eight preschool children, with a mean age of 4-1, served as subjects. All were enrolled in a half-day preschool at the Edna A. Hill Child Development Laboratory, Department of Human Development and Family Life, University of Kansas. It had been determined by an informal classroom assessment that these children did not know their telephone numbers. These subjects were divided equally for the experimental and control groups. The sessions were conducted in a small experimental room adjacent to the classroom at a child-sized table.

Experimental Design

A group design was used with pretest-training-posttest format, which included retention tests at two, four, and six weeks after the posttest for both experimental and control groups. During training, daily criterion-level probes were administered at the beginning of each session to assess acquisition. The required telephone number training responses for both groups were equivalent.

Materials

During pretest, posttest, and retention tests, commercial manipulative materials were provided for the subject to work with, hopefully, to occupy the child and avoid boredom during the repeated trials.

During training, no materials were used in the Straight-Chaining

(control) procedure. However, for Dramatic-Play (experimental) training, materials for training included small cardboard or plastic props which varied, depending on the numerals being trained (see Figure I). The mnemonic verbal and motor responses associated with each numeral

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Insert Figure I about here

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were: 1) "Circle the sun"/move bird around sun; 2) "Shine the shoe"/brush toe of shoe; 3) "Swim the sea"/move doll across surface of water; 4) "Shut the door"/push door closed from open position; 5) "In the hive"/place bee inside hive; 6) "Tap the sticks"/touch sticks together; 7) "This is Mr. Kevin"/turn picture around; 8) "Open the gate"/pull gate open from closed position; 9) "Now we dine"/lift fork to mouth; 0) (Pronounced "oh") "Dig and hoe"/move rake across table.

Procedures

Dependent Variables. The dependent variables were the subject's verbal responses to the criterion-level and training instructions, and, in Dramatic-Play training, the motor and additional verbal responses on training trials, as described above. A correct verbal response was defined as verbalizing the digits of the phone number which had been trained, in the correct sequence. Correct additional motor and verbal responses on Dramatic-Play training trials were defined as approximate imitations of the experimenter models for those responses. All incorrect digit responses were recorded and analyzed to determine the number of memory-item errors (omissions, additions, replacements, and repetitions) and memory-link errors (reversals).

Figure 1

DRAMATIC-PLAY TRAINING MATERIALS

General Training Procedures. Both the Straight-Chaining and Dramatic-Play training packages contained the same basic procedures, with only the addition of props and the related verbage and motion in the Dramatic-Play procedures. In both types of training, the seven digits of the phone number were progressively chained in units, as follows: the three digit exchange was unit one, the next two digits were unit two, and the final two digits were unit three. Each unit was trained in two sessions of seven training trials each, making a total of six training sessions. All training sessions began with a criterion-level probe trial and ended with a "Desirability Check" trial. At the termination of training trial six, the subject was asked, "Do you want to do it one more time?" If the subject responded "yes," the seventh training trial was administered. If a subject refused the seventh trial, it was administered following the criterion-level probe at the beginning of the next session. Thus, all subjects received the same number of training trials on each unit, and over all.

For both types of training, all correct responses were followed by a verbal praise statement, sometimes paired with physical contact. All incorrect responses on training trials were corrected, but pretest, probe, posttest, and retention test trials were not.

Both training packages utilized an auditory cue consisting of the experimenter verbalizing the digits simultaneously with the subject. This cue was faded in volume across the first four training trials of each session. Prompts, either physical or verbal, were also used, as needed. In both procedures, the training instruction, "What's your number?" was changed to the criterion-level instruction, "What's your phone number?" across the first four training trials in the final session

by a reversal of the volume fading procedure used for the auditory cue.

The format for all pretests, posttests, and retention tests was standard. The subjects were provided with a manipulative task and asked to work with it for a few minutes. As the subject worked, the experimenter made random conversation for three to five minutes, introducing the criterion-level instruction twice during the conversation. Verbal praise, occasionally paired with physical contact, was given for working with the manipulatives provided.

Straight-Chaining Training Procedures. At the start of each session, the trained digits were modeled for the subject, followed by repeated trials of the training instruction only. The two training sessions per phone number unit were identical.

Dramatic-Play Training Procedures. Subjects receiving this training were also trained, during the first training session for any unit, on verbal and motor responses for use with the props, as described in Materials. In the second session for each unit, the subjects were trained to fade their prop involvement across the first four trials.

Additionally, during the pretest for these subjects, their ability to detect rhyming word-pairs was assessed. The subjects were asked to respond to six word-pairs, three of which rhymed and three of which did not, by saying whether they sounded alike.

Recording and Reliability. Data were recorded on a discrete-trial basis on a pre-coded data sheet. Reliability data were recorded for almost all sessions, with at least one reliability check per condition, per subject. Reliability was computed with the following formula:

$$\frac{\text{Number of Agreements}}{\text{Number of Agreements + Number of Disagreements}} \times 100$$

Reliability

Reliability figures ranged from 89% to 100%, with a mean of 97% for all conditions and all subjects, combining the categories of training instructions, auditory cues, corrections, prompts, subject responses, and verbal and physical reinforcers (see Table 1). Reliability for subject responses, only, also ranged from 89% to 100%, with a mean of

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Insert Table 1 about here

97%, for all subjects and all conditions.

Training

Acquisition. Figure II shows the percentages of subjects in each of the training groups demonstrating 100% acquisition on the posttest, and on the three retention tests. While 75% of the Straight-Chaining subjects demonstrated acquisition on the posttest and 100% demonstrated

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Insert Figure II about here

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retention on the first and second retention tests, only 50% of the Dramatic-Play subjects demonstrated acquisition and retention in these three conditions. On the third retention test, 75% of the Straight-Chaining subjects demonstrated retention, as compared to only 25% of the Dramatic-Play subjects. This indicates that one subject in each group did not maintain the response between the second and third retention tests.

Figure III shows the individual subject data for correct initial

TABLE 1

RELIABILITY FIGURES

	INSTR.	AUDITORY PROMPTS	CORREC-TIONS	PROMPTS	SUBJECT RESP.	S^{R+}
DRAMATIC-PLAY						
PRE/POSTTEST	100	*	*	*	100	97
TRAINING	100	99	97	92	89	96
RETENTION	100	*	*	*	90	95
STRAIGHT-CHAINING						
PRE/POSTTEST	100	*	*	*	100	93
TRAINING	100	99	94	90	99	98
RETENTION	100	*	*	*	95	94

*No occurrence in this condition.

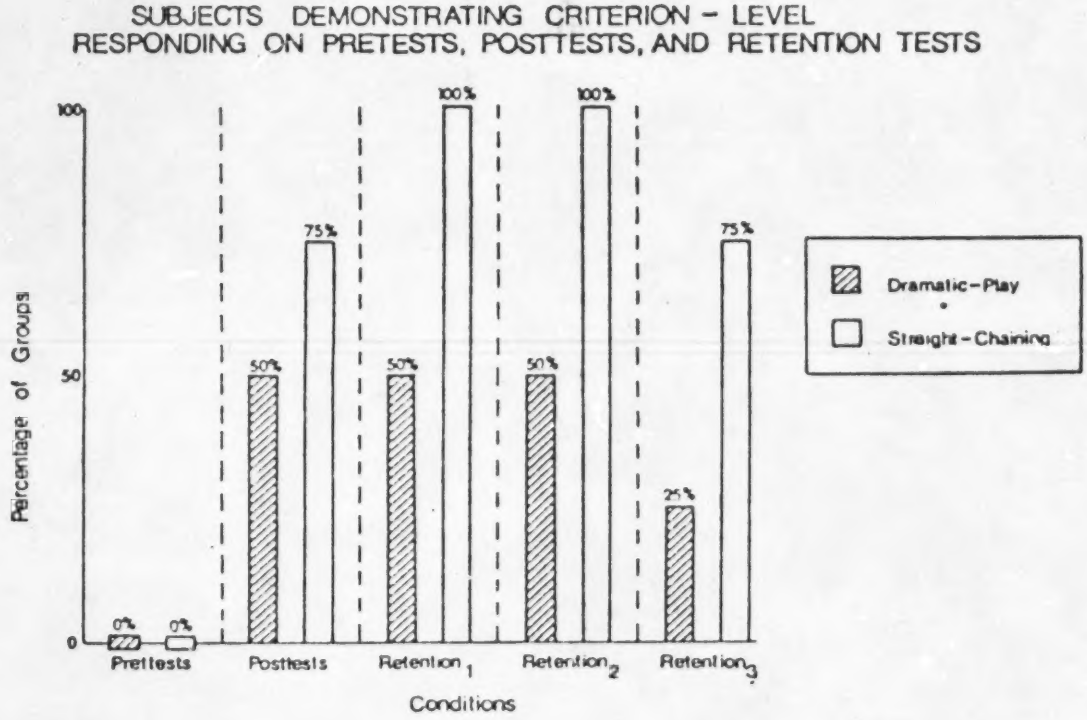
FORMULA:

$$\frac{\text{number of agreements}}{\text{number of agreements + number of disagreements}} \times 100 = \text{Percentage reliability}$$

Figure II

SUBJECTS DEMONSTRATING CRITERION-LEVEL RESPONDING

ON PRETESTS, POSTTESTS, AND RETENTION TESTS



responding. The mean percentage of initial correct responses across all conditions for the Straight-Chaining group was 83.22%, while for

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Insert Figure III about here

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the Dramatic-Play group, it was 64.87%.

Incorrect responses. Figure IV shows the group data for mean number of incorrect responses, cumulative across all conditions. Only group data are shown, as they parallel the individual data. The mean number

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Insert Figure IV about here

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of incorrect responses made by the Dramatic-Play subjects was 13.5, while for the Straight-Chaining subjects, it was 6.65.

Error analysis. When the incorrect responses were analyzed for memory-link and memory-item errors (see Method), results showed a minimal difference in the type of error made by each training group. Table 2 shows these results for each subject and for each training group. Seventy percent of the errors made by Straight-Chaining subjects were memory-item

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Insert Table 2 about here

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errors and 74% of the Dramatic-Play subjects' errors fell in this category. The Straight-Chaining subjects made 30% memory-link errors, while the Dramatic-Play subjects made 26% of their errors in this category.

Rhyming

Table 3 shows the results of the rhymed vs. non-rhymed word-pairs

Figure III

CORRECT INITIAL RESPONDING ON TELEPHONE NUMBER TRAINING

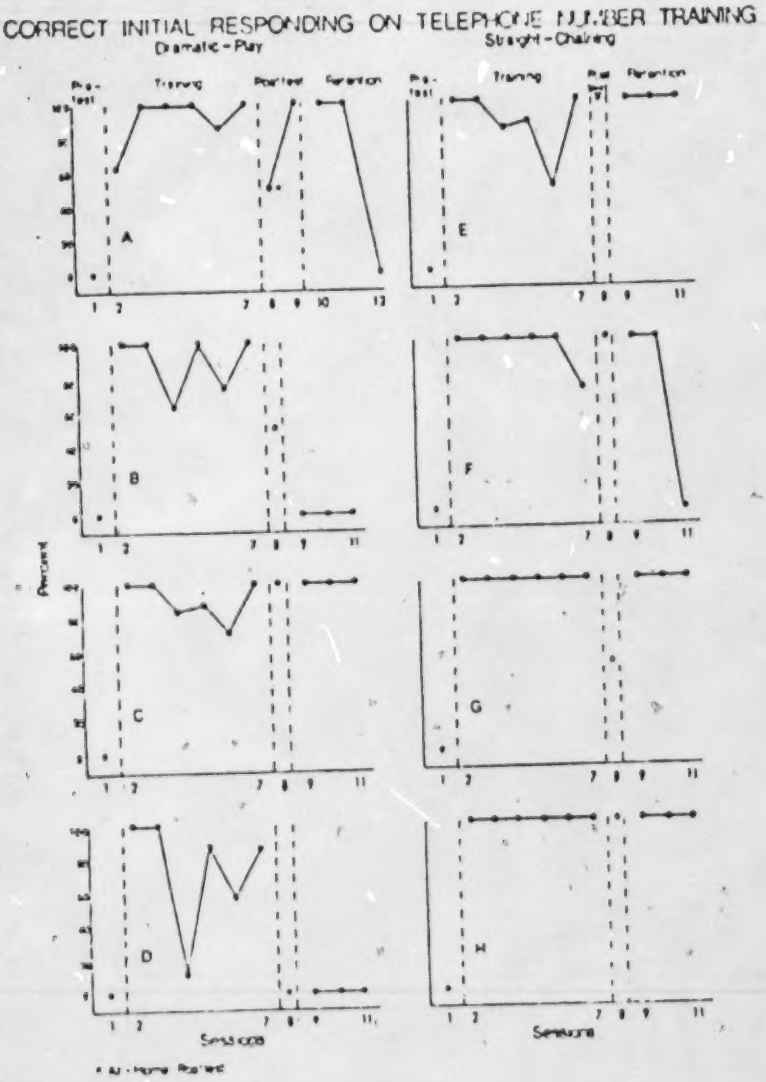

Figure IV

GROUP MEAN CUMULATIVE INCORRECT RESPONSES

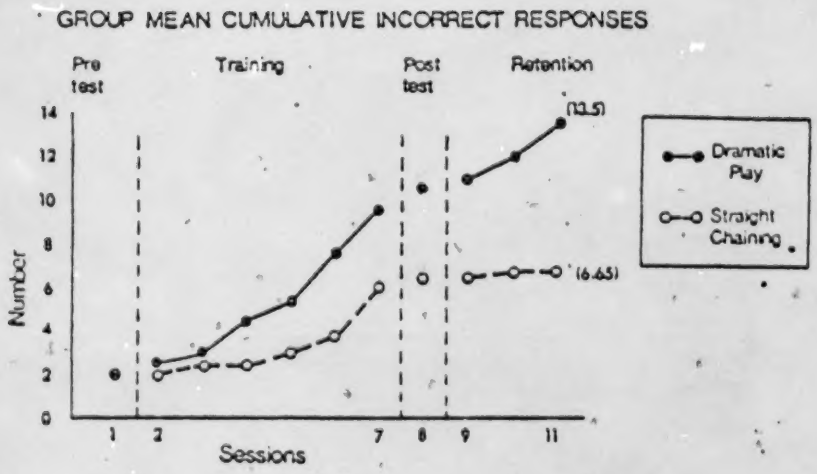

TABLE 2

ERROR ANALYSIS:

MEMORY-ITEM ERRORS AND MEMORY-LINK ERRORS IN

STRAIGHT-CHAINING AND DRAMATIC-PLAY PHONE NUMBER TRAINING

DRAMATIC-PLAY	TOTAL M-I ERRORS	TOTAL M-L ERRORS	PERCENTAGE M-I ERRORS	PERCENTAGE M-L ERRORS
Subject A	7	2	78	22
Subject B	12	6	67	33
Subject C	36	11	77	23
Subject D	44	16	73	27
Group Total	99	35	74	26
Group Mean	25	9	74	26
STRAIGHT-CHAINING				
Subject E	21	9	70	30
Subject F	0	0	0	0
Subject G	24	7	77	23
Subject H	6	6	50	50
Group Total	51	22	70	30
Group Mean	13	6	70	30

FORMULAE:

$$\frac{\text{Total M-I errors}}{\text{Total M-I errors + Total M-L errors}} \times 100 = \% \text{ M-I errors}$$

$$\frac{\text{Total M-L errors}}{\text{Total M-L errors + Total M-I errors}} \times 100 = \% \text{ M-L errors}$$

assessment for Dramatic-Play training. All four subjects identified at

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Insert Table 3 about here

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least two out of three rhymed-word pairs and three of the four subjects identified all non-rhymed word-pairs.

Desirability Checks

Table 4 shows the number of times each subject chose the final training trial out of the six sessions. With the exception of one subject in

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Insert Table 4 about here

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each training group, all subjects chose the trial when it was offered in each session.

Discussion

It is obvious from these data that the subjects who received the Straight-Chaining, or rote memorization, procedure completed training with fewer incorrect responses and were able to demonstrate acquisition of the verbal chain (phone numbers) more accurately and for a longer time than the subjects trained with the mnemonic game, or Dramatic-Play procedure. There are many plausible factors which may have contributed in part to the ineffectiveness of the Dramatic-Play training, as compared to Straight-Chaining.

First, it is important to know that a seven-digit chain is rather long for a preschool child to recite without visual or verbal prompts.

TABLE 3

DRAMATIC-PLAY SUBJECTS' KNOWLEDGE OF RHYMING WORDS

SUBJECT	# CORRECTLY IDENTIFIED RHYMED-WORD PAIRS OF THREE PAIRS	# CORRECTLY IDENTIFIED NON-RHYMED WORD PAIRS OF THREE PAIRS
A	3	3
B	2	3
C	2	3
D	2	0

TABLE 4

DESIRABILITY CHECK:

EXTRA TRAINING TRIALS CHOSEN BY

DRAMATIC-PLAY AND STRAIGHT-CHAINING SUBJECTS

MULTIPLE BASELINE GROUP	DRAMATIC-PLAY		STRAIGHT-CHAINING	
	SUBJECT	# TRIALS OUT OF SIX	SUBJECT	# TRIALS OUT OF SIX
I	A	6	E	3
II	B	2	F	6
III	C	6	G	6
IV	D	6	H	6

The 1972 Stanford-Binet norms for the ability to repeat a chain of numerals are: two digits for a two-year-six-month old, three digits for a three-year-old, and five digits for a seven-year-old, with a criterion of one repetition correct in three attempts. A four-year-old is likely to have a digit repetition span of three or four, whereas a six or seven digit span might be expected of a 12-year-old (Flavell, 1977). Braga and Braga (1975) state that most children of four and five can memorize four numerals or a sentence of eleven syllables (It is interesting to note that none of the verbal responses in the Dramatic-Play training procedure exceeded six syllables in length, and there was anecdotal evidence to show that subjects who could not recite their phone number digits correctly following training could easily recite the verbal responses associated with the props.)

In combination with the difficulty of reciting a seven-digit chain, Dramatic-Play subjects also had to acquire a long chain of verbal and motor responses. Thus, they had more responses to acquire than the Straight-Chaining subjects who were not trained on the additional responses. These additional responses could have made the task more difficult.

Another possible explanation for the poor performance of subjects in the Dramatic-Play procedure is the lack of criterion-related cues in the verbal and motor responses which were to have served as mnemonic recall cues. A study comparing criterion-related and noncriterion-related cues (Schilmoeller and Etzel, 1977), in training a difficult visual discrimination, demonstrated that cues which are not related to the criterion responses cease to be functional in facilitating correct responding, once they are faded from the training procedure. Since the verbal responses required of Dramatic-Play subjects were related to the digits trained only in that they rhymed, it seems possible that they served as

noncriterion-related cues and thus did not facilitate correct responding on the posttest.

Rhyming and stimuli alone were apparently not sufficient in this case to facilitate recall. The technique of using a numerical rhyme for this purpose is cognitively complex, involving multiple stages of symbolic transformation and coding, from stimuli to "images" and back to words, together with the implicit assumption that acquisition of images is somehow easier than acquisition of digits (Paivio, 1969). Such abstract and symbolic thought processes appear to be beyond the scope of preschool children.

One other factor which may have contributed to the lack of acquisition in the Dramatic-Play group was the use of daily probes. Since these subjects were making more incorrect responses during training, they were also more likely to give incorrect responses on probes. Some developed a pattern of incorrect responding (e.g., "I don't know.") in the probe format which carried over to the posttest and retention tests, which used a similar format. In Stella and Etzel (submitted for publication), it was demonstrated that daily probes can lead to the development of these types of error patterns.

One failing in the design should be noted for any future attempts at replication. The measure intended to demonstrate the difference in amount of enjoyment experienced by the subjects in the two procedures was not an effective measure. Of the two subjects who ever refused the final trial, or Desirability Check, one was in the Dramatic-Play group and one was in the Straight-Chaining group. The common denominator appears to have been that both subjects had a repeating digit in their phone numbers and made more incorrect responses than other subjects. For

the remaining subjects, it appeared that the "fun" of working one-to-one with a teacher masked any differences in enjoyment of the procedures which may have existed.

It can be seen in Figure III that subject A was given two post-tests. The final training session for this subject fell on the last day of the preschool week, so that a three-day weekend would have elapsed prior to the posttest. Special permission was received to administer the posttest at the subject's home, the day after training was completed. The subject appeared distracted by the novel situation and did not respond correctly on one of the two trials. The posttest was readministered in the usual setting, following the weekend.

Despite the difficulty of the task for the age-group involved, it is obvious that the type of training procedure used greatly influenced acquisition in this study. Among the many possible explanations for the ineffectiveness of the Dramatic-Play training, as compared to Straight-Chaining, it is impossible to determine which, if any, contributed to the results. If it is true that these preschoolers were unable to recite their phone numbers because they were acquiring the game component responses, then there are strong implications here for further study. It may be that children at the early elementary levels are also susceptible to interference from the game components intended to help them learn. If the games used also rely on mnemonic devices designed to promote mental imagery, then early elementary school-aged children would also be incapable of the complex, formal thought processes necessary to utilize the cues at recall. Although memorization is often blamed for the frustration of students, this may be an unjust accusation since the subjects in this study acquired their phone numbers efficiently by rote memorization.

With the recent media hue and cry about the incompetence of many supposedly educated children, it is imperative that empirical studies be generated to examine more closely the effectiveness of teaching with the games to which these students are being exposed. The results of this study might contribute to a "new" educational trend -- back to rote methods.

Footnotes

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[2]Reprints may be obtained from Elizabeth M. Goetz, Department of Human Development and Family Life, University of Kansas, Lawrence, Kansas 66045.

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